GAS LEAKAGE MONITORING OVER THE NET WITH RASPBERRY PI

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To my beloved parents, Ahmad Razli bin Ismail and Anida binti Mohamad, siblings, friends and all lecturers. Dedicated in thankful appreciation for your supporting, encouragement and best wishes.

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ABSTRACT

The purpose of this project is to develop an online data monitoring system for the gas detector over the NET. This system will detect the gas leakage especially in oil and gas industry. The gas sensor used for development of this system is the combustible gas sensor MQ-5 that used in order to detect the present of liquefied petroleum gas (LPG) and butane gas. This sensor can detect gas concentrations anywhere from 200 to 10000ppm according to the voltage output of the sensor. The output of the sensor is connected to Arduino Uno. A 20x4 size LCD, buzzer and three different colours of LEDs is used to indicate the levels of the gas for local monitoring which are safe, warning and danger level. The system is programmed with Visual Studio 2015 software whereas the Raspberry pi will send the data reading from the gas sensor to monitoring system through Azure IOT Hub cloud that will display the reading on user interface application graphically on Power BI. Thus, user can take immediate action upon the leakage occurs to prevent the condition becoming worst.

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ABSTRAK

Tujuan projek ini adalah untuk membangunkan sistem pemantauan data penggera untuk mengesan gas melalui internet. Sistem ini akan mengesan kebocoran gas terutama dalam industri minyak dan gas. Sensor gas yang digunakan dalam membangunkan projek ini adalah sensor gas MQ 5 yang akan mengesan kehadiran Gas Petroleum Cecair (LPG) serta gas butana. Sensor ini dapat mengesan mana-mana kepekatan gas daripada 200ppm hingga 10000ppm mengikut keluaran voltan sensor yang ditunjukkan. Keluaran daripada sensor ini akan disambungkan pada Arduino Uno. Satu LCD bersaiz 20x4, satu alat pembunyi isyarat dan tiga biji LED digunakan untuk menyatakan aras bagi gas iaitu aras selamat, amaran dan bahaya. Manakala Raspberry Pi akan menghantar data maklumat daripada sensor gas kepada sistem pemantauan melalui penyimpan data Azure IOT Hub yang akan memaparkan bacaan melalui aplikasi antara muka pengguna secara grafik pada Power BI. Oleh itu, pengguna boleh mengambil tindakan segera ke atas kebocoran berlaku untuk mengelakkan keadaan menjadi teruk.

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LIST OF AMBREATIONS

A/D	-	Analog to Digital
UV	-	Ultra Violet
SnO2	-	Tin Dioxide
CO	-	Carbon Monoxide
H2	-	Hydrogen
H2S	-	Hydrogen Sulphide
C7H8	-	Toluene
C8H10	-	Ethylbenzene
Ppm	-	Part per million
PCA	-	Principal Component Analysis
PC	-	Principal Component
SV	-	Single Varieties
ANN	-	Artificial Neural Network
DC	-	direct current
I/O	-	Input and Output
USB	-	Universal Serial
PWM	-	Pulse Width Modulation
SRAM	-	Static Random Access Memory
EEPROM	-	Electrically Erasable Programmable Read Only Memory
KB	-	Kilobytes
GND	-	Ground
GPIO	-	General Purpose Input Output

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CHAPTER I

INTRODUCTION

This chapter will be explain on the project background, objective of the project, problem statement of the project, scope of project, methodology and also the report structure.

1.1 Background

Security is a level of protection in a scope of area against dangers and losses. In industry area, the environment and its condition is very important to ensure the safety and security of the workers. When discussing on security issues, people cannot take it for granted. Consequently, the issues from environment and the air quality in industrial area are discussed to increase the alertness and responsibility regarding the environment towards public and workers' safety. The dangerous gases such as CH_3, and CO may bring harmful effect towards human as they may cause explosions and CO poisoning accident in most industrial areas. Then, it is certainly possible that the gases may leak and the system needs to be real time monitored.

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Thus, a gas detector is invented to ease human on detecting the presence of those dangerous gases within an area to prevent any disaster happen. The gas detector is a gas detecting device that used to be applied in dangerous place. Nowadays, the world become full of new technology. The gas detector has been innovated into various ways of detection, for example infrared thermal imaging gas leak detection [1], gas leakage detection with monitoring system [2], and wireless gas sensor network [3]. This thesis presents the design and development of a wireless gas leakage monitoring system by using Raspberry Pi.

Besides, traditionally the gas leakage monitoring system is implemented by communication cable system, therefore the cost of installation and maintenance are very expensive and difficult as mentioned by J.Ding [4]. Thus, in order to overcome these restrictions, wireless sensor network is chosen as the best choice in the situation above. Some related papers proposed different types of wireless sensor network such as radio frequency (RF) transceiver [3], router and coordinator [5], general packet radio service (GPRS) network [6] and Zigbee [2][4][7][8]. This project will use Raspberry Pi in the gas leakage monitoring application field for the real-time monitoring of the potential risk areas.

In this project, the monitoring system is developed and implemented by using Visual Studio 2015 software for Windows programming. It is used to send the data from the sensor to Azure Microsoft cloud platform. Then it will display the level of gas concentration in a workplace through online Power BI application that can be monitored through another remote PC and via internet server. This wireless communication will reduces the hassle of making a new connection and will increase the network range. Hence, it provides benefit to monitor the condition of a room in a safe distance.

The user can easily monitor the gas leak information by connecting to the internet using computer or Smartphone directly. User can monitor their gas leak information by login into the Power BI online web page. The data can be analyzed by see the graph at web page that automatically update for every 10 seconds. The web page will refresh automatically after 10 seconds. It will make the system convenience to the user to

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monitor their gas leak information at anywhere as long as they have internet connection.

In actual, the hardware included in this system is MQ-5 Gas Sensor, Raspberry PI 2, 2 Arduino Uno and PC to monitor the signal of the gas leak. The sensor has excellent sensitivity combined with a quick response time at low cost and ease installation. Under gas leaked condition, the alert warning notification will automatically show on user interface. Through this real-time notification, the system will decrease the response time of the responsible person that handle the system to take any action. Thus it will provide the immediate aid to the situation occur.

1.2 Problem Statement

In oil and gas industry, a gas leak is hazardous to personnel and industrial operation. A quick detection and alert would minimize the dangers of gas leak. Besides, in certain time, the proper person that responsible of monitoring the gas leakage in the workplace may have meeting or other outside works that could make him or her cannot access the alert on the information of gas leakage. Traditionally, the gas pipeline leakage monitoring system is realized by communication cable system, therefore the limitation range of coverage could occur. In order to overcome these restrictions, wireless sensor network is chosen as the best choice in the situation above.

1.3 Objectives

The objectives of this project are:

1. To make user able to take immediate action against the gas leak.
2. To make the gas leak information can be accessible and monitored from anywhere.
3. To develop an automatic system that can detect and alert gas leak using Internet of Things (IoT) technology and Raspberry Pi.

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1.4 Scope of Project

In the effort of achieving the project objectives, several scopes have been outlined. The development of this project is estimated to involve 40% of hardware and 60% of software. The scopes of the project involve:

i. Developing gas detecting system that will detect the flammable gas leakage and monitored it over the NET. The system will be modelled based on PETRONAS Kertih working environment.
ii. The gas sensor MQ 5 is used by this system to detect the leakage gas.
iii. Raspberry Pi device is used by this system to transmit the data from the sensor to user interface over the NET.
iv. Developing a communication between wireless sensor network and the web server.
v. Developing a synchronization database between web servers and cloud storage that enable the user to access the data on long distance or remote communication.

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CHAPTER II

LITERATURE REVIEW

This chapter will discuss in more details on the components and instruments that used for this designed project in general. Besides, there are some of past related project or paper work that is related to this project.

2.1 Previous Projects Related to Wireless Sensor Nodes

2.1.1 ZigBee Wireless Sensor Nodes

A project that related to Wireless Sensor Node is project paper with title "Carbon Monoxide Detection and Autonomous Countermeasure System for a mill use Wireless sensor and Actuator Network" by University of Engineering and Technology from Peshawar, Pakistan [3]. It designed with high a high end central controller. The PC is then connected to the TelosB wireless sensor module via USB and connected to the actuator circuit via RS232. The TelosB node is connected with CO sensor module and interface with ZigBee wireless connectivity

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